

WARP AND WOOF

BOOK ONE
THE LINEN INDUSTRY



EDUCATIONAL PUBLISHING CO.

WARP AND WOOF

THE STORY OF THE TEXTILE ARTS

BY

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I

THE LINEN INDUSTRY

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FOREWORD

It has been a pleasure to bring together for comparison the primitive methods used in preparing materials for clothing and the modern methods found in the factories; also to search for the historical significance and progress of the knowledge of the art. For encircling this primitive art may be found many stories of fancy that make what otherwise might seem to be a tedious process one of great pleasure. These stories enliven the interest in the methods and almost create a desire for ability in the craft itself. The knowledge of a craft has a social significance which is recognized in educational circles as important for the adult as for the child. Not only is this recognized in the manual training, but also in the new, so-called, household arts. If the text brings to the student or reader an eagerness to share a larger interest in the historical value of the knowledge of the craft or a personal desire to have a share in the production of the material as a craft, this little volume will bear a true message from

THE AUTHOR



THE LINEN INDUSTRY

I

HISTORICAL NOTES

EGYPT

Linen is one of the most interesting of textile fabrics because its history can be traced four thousand years, and because the flax fibre, from which linen is made, undergoes many and varied processes in the manufacture of the white and glistening material, honored by all men and nations.

In tracing its history, the monuments on the banks of the Nile, and scriptural records, yield the most authentic accounts of its early use and manufacture.

Egypt was famous for her beautiful products of fine linens; at one time the chief and most profitable article of commerce. Reproductions of the drawings in the tombs of Beni-Hassan,

show the processes, from the sowing of the seed to the finished piece of cloth. ("The Ancient Egyptians," J. Gardner Wilkinson, Chapter IX.) One of the most interesting instances of the use of linens is found in the wrappings of the mummies, large quantities being used in embalming men and animals; varying from the coarsest texture, like sail cloth, to the finest quality, which requires a microscope to discern the flax fibre. Fine examples are seen in the museums, which testify not only to the quality, but to the beautiful color designs woven in as borders. The mummy cloths vary from a few inches to one yard in width, and sometimes measure three hundred yards in length. These bandages also varied in fineness, according to the wealth of the deceased.

White linen was used exclusively for garments of the priesthood and royal personages; the colored costumes, represented on the wall paintings, show elaborate designs in embroidery. The common people wore gowns of indigo colored linen.

Herodotus describes a corselet presented by Amasis, King of Egypt, to the Lacedæmonians: "It was of Linen, ornamented with numerous figures of animals, worked in gold and

cotton. Each thread of the corselet was worthy of admiration; for though very fine, every one was composed of three hundred and sixty other threads, all distinct, the quality being similar to that dedicated to Minerva, at Lindus, by the same monarch." (Herodotus ii., 182, iii., 47.)

Pliny describes Egyptian fish-nets — "Some of them were so delicate that they would pass through a man's ring, and a single person could carry a sufficient number of them to surround a whole wood. Julius Lupus, who died while Governor of Egypt, had some of these nets, each string consisting of one hundred and fifty threads." Portions of this kind of net have been discovered at Thebes. (Pliny xix., 1.)

The sail cloths made in Egypt were prized by the Tyrians; they were frequently adorned with painted or embroidered devices. "The ship in which Anthony and Cleopatra went to the battle of Actium was distinguished from the rest of the fleet by its purple sails, which were the peculiar privilege of the admiral's fleet. The sails of the large ship of Ptolemy Philopator, mentioned by Atticus, were also of fine linen, ornamented with a purple border."

PALESTINE

Sacred History, the Bible, gives the earliest written records of the use of linen. The first mention of linen is in Genesis, at the time Pharaoh exalted Joseph to a high position in the kingdom. He “arrayed him in vestures of fine linen” (Genesis xli., 42) — a great distinction, permitted only to members of royal families, priests, or people holding official positions. Linen was used for the curtains of the Tabernacle (Exodus xxvi., 31), the priests’ bonnets, their garments (Exodus xxviii., 42), vestments, lampwicks; and the “women that were wise-hearted did spin with their hands, and brought that which they had spun, both of blue and of purple, and of scarlet, and of fine linen,” as an offering to the Lord. (Exodus xxxvi., 8.) Little “Samuel ministered before the Lord, being a child, girded with a linen ephod.” (I. Samuel ii., 18.) “And Solomon had horses brought out of Egypt and linen yarns; the king’s merchants received the linen yarn at a price.” (I. Kings x., 28.)

Flax is mentioned at the time of the plagues — the plague of hail — “the flax and the barley were smitten, for the barley was in the ear, and the flax balled.” (Exodus ix., 31.) The

spies sent out by Joshua to view the land of Jericho, were hid by Rahab: "She had brought them up to the roof of her house, and hid them with the stalks of flax, which she had laid in order upon the roof of her house." (Joshua ii., 6.) It is said of Samson, when bound with new cords to be delivered to the Philistines, "the cords that were upon his arms became as flax that was burnt with fire." (Judges xv., 14.) In Proverbs, the virtuous woman "seeketh wool and flax, and worketh willingly with her hands." (Proverbs xxxi., 13.) In other references, linen is used as a symbol of purity on earth, and of glory in heaven; it has also been used as a symbol of firmness, because difficult to tear; of incorruption, and of clearest splendor — because whiter when cleansed.

References

Isaiah, xix., 9; xlii., 3; Leviticus, xix., 19; Deuteronomy, xxii., 11; Matthew, xxvii., 59; Revelation, xix., 8-14; xv., 6.

PHOENICIA

The maritime relations of Phœnicia with all countries along the Mediterranean Sea made her towns, Tyre and Sidon, of great commercial importance; to such an extent that her

traders were called "merchant princes." The Phœnicians, for many years, imported Egyptian linens for clothing and sail cloths; but they were especially noted for the crimson colored linens, called purple. "When the beautiful purple of Tyre was first discovered the sovereign to whom it was presented appropriated it as a royal distinction, hence to assume the purple became significant with being chosen king. Homer mentions that purple was only worn by princes." The purple dye was obtained from two shell-fish, from a sack in the back of the neck, which held a white garlic-like fluid that was extracted while the fish was alive. When the material was dipped in this extract and exposed to the light, it turned first green, then blue, then red, and finally a deep purple; after washing in soap it became a permanent crimson color, called royal purple.

An interesting myth describes the manner of the discovery of the dye. Heracles, an ancient god, started with his dog for a walk along the shore, to visit a beautiful maiden, Tyros. While walking, quite absorbed in the anticipations of meeting his lady love, he forgot his dog, who not having food of love for consolation, appeased his appetite by eating a shell-fish, sunning on a stone. When Heracles' visit with Tyros

was nearly ended, and he asked the privilege of returning, Tyros suddenly discovered that the dog's mouth was a beautiful purple color, hitherto unknown. With a spirit of possession, she replied to her lover that she would not see him again until he could bring her a robe of the same beautiful color as the mouth of the dog. Heracles, although not noted for an inventive mind, after considerable research discovered the fish and was again reinstated in the favor of Tyros.

GREECE

Linen was one of the chief imports of Greece from Egypt and Phœnicia. To Pliny and Pausanias we are indebted for the knowledge that flax was grown in Greece in ancient times. Doubtless the same spirit which produced the classic art and literature of Greece — that of original and artistic perfection — produced the costly materials of exquisite workmanship, often mentioned in classic literature. The charming style of linen garments, worn by Grecian women, were frequently depicted on the monuments; these sculptured pictures portray ample folds, and flowing garments, which added grace of line and dignity to the figure.

Homer describes not only the exquisite texture of the linen materials, but suggests that the art of weaving, the greatest of household accomplishments, is a fit task for the goddesses. "Now Iris went with a message to White-armed Helen, in the likeness of her husband's sister — and in the hall she found Helen weaving a great purple web of double fold, and embroidering thereon many battles of horse-taming Trojans and mail-clad Achæians, that had endured for her sake, at the hands of Ares." (*Iliad*, Book III., l. 122.) "Forthwith she veiled her face in shining linen." In the battle of Tydides and Aphrodite, he wounds her "straight through the ambrosial raiment that the Graces themselves had woven her." (*Iliad*, Book V., ll. 315–347.) "And Athena, daughter of ægis-bearing Zeus, cast down at her father's threshold her woven vesture many colored, that herself had wrought and her hands had fashioned." (*Iliad*, Book V., ll. 733–736.) "And Patrocles bade his fellows and handmaidens spread with all speed a thick couch for Phœnix; and they obeyed and spread a couch as he ordained, fleeces and rugs and fine flock of linen." (*Iliad*, Book IX., l. 660.) Carpets of purple cover the divans at the reception of Odysseus by Achilles. (*Iliad*, Book IX., l. 200.) The Grecian

women were the first, it is claimed, to use a small square of linen for a pocket handkerchief; for which Aristophanes said, "the old men preferred a fox's tail."

There is hardly a book in the Iliad which does not refer to linen and the noble art of weaving; and the proverbial web of Penelope, in the Odyssey, gives added honor to her charms of wit and grace.

But this a work she made
So hugely long, undoing still in night
By torches, all she did by day's broad light.

Because wise Pallas hath given wills to it
So full of art, and made her understand
All works in fair skill of a lady's hand.
But (for her working mind) we read of none
Of all the old world, in which Greece hath shown
Her rarest pieces, that could equal her;
Tyro, Alcmena, and Mycena, were
To hold comparisen in no degree,
For solid brain, with wise Penelope.

— *Chapman, Odyssey, Book II., l. 137.*

In early times, the Island of Delos was the emporium for linen products; she sent exports of linen to all ports on the Mediterranean Sea; until the war of Mithridates closed her commercial interests.

Alexander the Great is said to have bound up

the wounds of Lysimachus, after battle, with his turban; the king's turbans were of linen ornamented with gold and precious stones, worn like diadems.

ROME

Rome owed her knowledge of linen and the textile arts to Greece; the wealth and luxury of the Roman citizen encouraged products from the loom of the finest textures, often embellished with gold and silver embroidery. Rome imported from her colonies fine linens, and the emperors established colleges or corporations for its manufacture, which supplied the court and officers of the army; thus the industry was carried wherever the Roman legion penetrated — Spain, Gaul, and the shores of England.

The citizen's robes and mantles were often very costly. Plutarch relates that Cato, on receiving one of these robes by inheritance, commanded it to be immediately sold, because he considered it too costly for a conscientious Roman to wear — showing his enmity to luxury.

Nero's dining-rooms were hung with Babylonian cloth, mentioned by Pliny, "worth about sixty thousand dollars." Gold and silver were probably combined with the linen, which in-

creased the value of the tapestries. Pliny also relates with contempt that the Roman ladies "cannot desire to go more rich and costly in their apparel than to wear linen." He describes their weaving establishments, which were placed underground to obtain more moisture and facilitate the spinning of very fine thread.

Linen was employed not only for articles of dress, especially worn by women, but also for bedding, table covers, napkins, hand towels, and bath towels.

With the downfall of the Roman power, several centuries, known as the dark ages, followed, when each tribe or family made only enough for home consumption. The great commercial interests lay dormant, until the re-awakening of the tenth century, when markets for all the textiles were again established.

ENGLAND

The conquest of England by William of Normandy (1066 A. D.), and the immigration from Flanders which followed, gave an impulse to English linen manufacture. In the early renaissance the linen of Flanders was famous and her artisans skilled in its manufacture.

A curious story is told of the case of a man in England who had been cited for offending against a law, then in force, to prevent the wearing of too wide breeches, and who pleaded in defence the exceeding utility of the extravagant fashion. In proof of which he produced from the proscribed garments a number of sheets, two table cloths, ten napkins, four shirts, and other linen articles, and was proceeding to the extraction of more, when the judge amidst much laughter, stopped and dismissed him."

The finest linen was imported from Holland, used principally for shirts, often elaborately embroidered, and costing fifty dollars apiece. Linen in some places was held at such value, that it was used for money.

UNITED STATES

With the colonization of America, the knowledge and use of linen was brought to these shores by the Pilgrim Fathers. Flax spinning and weaving in the colonies was a common household industry, until the invention of the cotton-gin, cheapening the cost of the manufacture of cotton which was then largely sub-

stituted for linen. There are beautiful examples of colonial linens which are to-day the pride of many households, and the grandmother's spinning wheel is treasured as an ornament for the best room of the house.

The Colonies of Massachusetts, Connecticut, Pennsylvania, Maryland, Virginia, and other places, as early as 1640, passed laws encouraging the production of flax, besides re-printing pamphlets of foreign publication, for the "Benefit of the Inhabitants," and recommended them to their perusal.

Of the later use and development of flax and linen manufacture in this country, a following chapter will treat.

To-day, the countries of Egypt, Greece, Holland, Belgium, Germany, Austria, Russia, Great Britain, and Italy yield flax fibre and export linens. In tracing the history of the textile it has been clearly seen that each country has apparently held tenaciously to an art which in early times was of commercial value.

II

THE FLAX PLANT.

The botanical name of the flax plant is *Linum usitatissimum*. The English word, linen, is derived from the generic name, *linum*, and the term lint, from the old Scotch word, *lin*. Flax grows wild in Egypt, and is cultivated all over the world. Botanists claim that there are at least one hundred species of the plant, with flowers of various colors, some yellow, white, flesh-color, red, and blue.

The plant of the *Linum usitatissimum* consists of a single stalk, growing from twenty to forty inches high, the average height about thirty inches; of a green color, with leaves alternating on the stalk; crowned with a beautiful blue flower of five petals sometimes called the fugitive flower, because the petals fall almost as soon as the blossom opens.

Plutarch writes that the reason the Egyptians used the flax plant, with the blue flower, for cloth, was because, "the universe itself is sur-

rounded with the ethereal blue of the sky." As soon as the petals of the flower fall, the seed bolls are formed; in each section, two cells are formed, each boll containing ten shiny, dark brown seeds. The seed has a medicinal quality, being used for poultices and flaxseed-tea; the outer coating contains a mucilaginous sub-



THE FLAX PLANT AND BLOSSOMS

stance, which has properties that are soothing to inflamed membrane.

The seeds are used for making linseed oil; first they are bruised, then heated, and subjected to hydraulic pressure, when they yield from twenty to twenty-seven per cent oil. This oil is especially valuable for varnishes because

of its drying properties. When the oil comes from the press, it is termed "raw oil," when subjected to heat, "boiled oil." The remains of the seed, after the oil is extracted, is made into a cake much used for fodder. When the flax is grown for seed, it is sown thinly, in order that the stalks may throw out a great many branches, and yield a large crop of seed. The



METHOD OF STACKING FLAX

fibre of the plant grown for seed is coarse and useless for fine materials.

To produce a good crop of flax fibre, great care is taken in the selection of the seed, which should be of the previous year's growth. The best seed comes from Riga—it is a Dutch seed. The ground should be carefully prepared, dry, of sandy loam, with strong sub-soil

— the climate, temperate and moist. It is sown in the early spring — April or May, and reaped in August when the stalks have turned two-thirds yellow. Flax yields a better quality of fibre after a rotation of crops, such as grass, oats, potatoes, and wheat; the same ground should not be used but once in six or eight years. It is necessary to harvest the flax by hand; the stalks are tied carefully and stacked in the open fields. In Germany, where the seed is saved, it is taken from the stalks by drawing them through a coarse comb.

Flax is cultivated in Russia, Germany, Switzerland, Italy, Holland, Belgium, France, Ireland, England, Scotland, Greece, and America.

Each stalk consists of a woody cylinder; outside of this and cemented to it, are the long, shiny fibres which are glued to an outer skin or bark. In order to separate these fibres from the outer skin or bark, the bark has to be retted or rotted away. There are several ways of retting flax. One method is to place the bundles of flax, with their roots down, in ponds; it is covered with straw and boards, and kept in the water until decomposition has liberated the bark from the fibre. This process is slow, requiring from ten days to two weeks. It has to be carefully watched, or the fibre will become

too brittle if allowed to remain in the water too long.

In Belgium the straw is placed in crates and submerged in the sluggish running river Lys, at Courtrai. The flax retted in this manner is of the finest quality, owing largely to the properties of the water.

In Russia another method is used, called

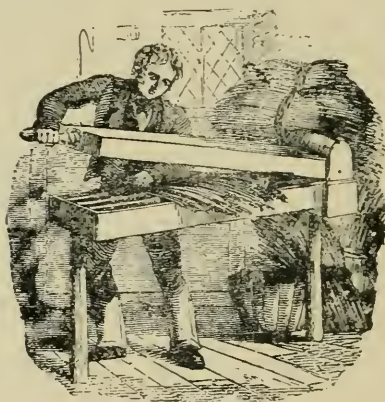


SHOWING METHOD OF FORMING STOOKS

dew-retting. The straw is placed in open fields on rather moist ground, where decomposition is accomplished by sun and rain. This form of retting takes a longer time.

When the bundles are taken from the water, they are at first stooked in the open fields, then opened, and allowed to dry. When completely retted the outer bark falls away very readily.

In order to make the fibre perfectly free, the inner woody cylinder must be disposed of; the removal of this pith is accomplished by a process called scutching. The primitive method was to break the stalk with the hand, then beat out the pieces of wood. In Ireland, to-day, it is said this is accomplished by breaking over a back of a chair; of course, this is only for



A BREAKER (PRIMITIVE)

household uses. A primitive pattern of a breaking-machine is shown in the illustration. Later improvements have been made, where fluted rollers are used to crush the flax. Scutching mills are established in flax growing districts. The particles of wood are removed by being placed in upright posts and combed with wooden

knives. As the flax is beaten, a certain amount of the fibre is whipped off, and is known in the Irish scutch mills as "codilla," a very cheap material used for coarse goods.

Flax now becomes commercial, with the finishing of these processes, and is ready for

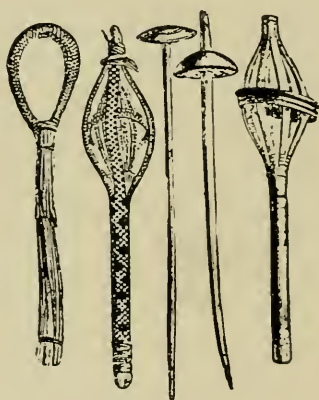


COMMERCIAL FLAX

the markets. It is characterized as a fibre, by its length, fineness, solidity, and suppleness—the length being especially valuable in spinning, as well as contributing to the durability of the textile.

The color and quality varies, owing to the

soil, climate, and process of retting used. It is sold usually in fourteen pound bundles, called in England a "stone," including one hundred pound lots, ranging in price from three to five shillings. The finest quality of flax brings often eight hundred dollars a ton, while the cheapest, only about one hundred dollars.



EGYPTIAN SPINDLES

SPINNING

The flax is made exceedingly smooth by careful combings, when used and made into yarn in the household.

For spinning, in early times, the distaff was used. The flax was fastened on loosely, in order that the fibres could be easily drawn out;

one fibre being joined to another by twisting and overlapping the ends; the end of the yarn was fastened to a spindle, usually weighted; as the thread gradually lengthened, the spindle spun round and round, falling to the ground. The illustration represents some Egyptian spindles in the British Museum.

Wilkinson describes them as follows:

The spindles were generally small, being about three inches in length, and several have been found at Thebes, and are now preserved in the museums of Europe. They were generally of wood, and, in order to increase impetus in turning, the circular head was occasionally of gypsum or composition; some, however, were of a light plaited work, made of rushes, or palm leaves, stained various colors, and furnished with a loop of the same materials, for securing the twine after it was wound. (Chapter IX.)

The spinner stood, holding the distaff in the right arm, and with the use of both hands pulled out the fibre, which was fastened upon the spindle, and gradually fell to the ground; when the spindle reached the ground, the thread was wound on the spindle and fastened, this operation was continued until the task was finished.

At the discovery of the lake-dwellers, in Switzerland, in 1865, forty spindles were found which were at least three thousand years old.

A gentleman traveling in a remote province

of England, in 1865, found a woman spinning with a spindle made of a potato fastened to a stick.

The spindle and distaff spread all over the world, but simple as they were, some tribes never made the discovery, and continued twisting fibres, by rolling them between the palms and thighs.

“Among our ancestors, the seventh of January was called St. Distaff’s Day, or Rock Day. This was because women resumed the rock or distaff on that Day, after the twelve days’ celebration of Christmas. After such revelry as accompanied the Christmas festival, it would not do to begin work too vigorously. The women, however, seemed to be more conscientious than the men, who played pranks with the flax and tow, in return for which the maids poured water over the men. Even as late as the days of Burns, a social assemblage was called a rocking because the lasses each brought her spinning apparatus or rock.”

THE MORROW AFTER TWELFTH DAY

Partly work and partly play,
You must work on St. Distaff’s Day,
From the plow soon free your team;
Then come home and fother them.
If the maids a spinning go,
Burn the flax and fire the tow;
Bring in pails of water, then
Let the maid bewash the men.

Give St. Distaff all the right;
Then bid Christmas sport good-night,
And next morrow every one
To his own vocation. — *Robert Herrick*

THE SPINNING WHEEL

The spinning of flax with the spindle was superseded about the beginning of the fourteenth century, by the invention of the spinning wheel; and in the early part of the sixteenth century the wheel was invented, at which the spinner sat.

The construction of the wheel varies — the distaff was fastened on to the frame in a perpendicular position, at the further end; and just below, the spindle revolved on a pivot, controlled by a cord attached to the wheel. The spindle held a bobbin, on which the flyer revolving with greater rapidity than the bobbin gave the thread the necessary twist.

The treadles to regulate the wheel were of later date. About 1764, the two-handed wheel, with two spindles, was invented. It is described as follows: "The frame of the machine stood on three feet, on the right of which facing the spinner, was a spoked wheel, of about two feet in diameter, with the rim slightly hollowed out-

side. Rapid motion was given to the wheel by a wooden rod or crank, connecting the axle of the wheel to the treadle or footboard, and moved at will by the foot of the operator, much in the same way as a lathe-turning is moved. On the left were two pirns or spindles, one for each hand, for receiving the yarn as it was spun, driven by means of bands of gut, or cords of flax or woollen yarns, tightly twisted, passing around the rim of the wheels and their axles. Each pirn or spindle had a flyer for twisting and guiding the thread before it was wound on the bobbin, which was a hollow reed slipped over the axle and fitting rather closely to it. The fly went round with great rapidity, while the bobbin being kept back by the strain of the thread, turned round on the axle only as fast as it was let out by the spinner. This depended upon the degree of twist intended by the spinner, and the skill of the operator. The rock or distaff with the flax wound round it in the manner best adapted for admitting of the filaments being readily drawn out by the spinner, was placed above the pirns, and both hands were employed in drawing out the fibres and forming the threads. The threads after being carried through a throttle or opening in the end of the spindle were from time to time shifted

along the flyer by means of small pieces of bent wire attached to it, for the purpose of filling the bobbin regularly with the yarn as it was spun. During the operation the spinner moistened the thread with saliva, the better to unite the fibres and improve the appearance of the yarn."

The wheels were often made of fine woods,



PRISCILLA SPINNING

Barse

beautifully polished, quite suitable to use in the drawing-room. Women of all classes learned the art, and one of the survivals of this universal custom is in the term "spinster," applied to unmarried women of an uncertain age.

Longfellow, in "Miles Standish," gives a charming picture of Priscilla at her wheel — "her white hands feeding the spindle, while

her foot on the treadle, she guides the wheel." In Evangeline, the hum of the wheel resounds, when "the maidens and matrons sat in white caps and kirtles — with distaff spinning the golden flax for gossiping looms — whose noisy shuttles within doors, mingle their sounds with the whir of the wheels, and the songs of the maidens." Evangeline, again, is seated — "spinning flax for the loom — while the monotonous drone of the wheel followed the old man's song."

The revival of the hand-spinning industry has been supervised by a Mr. Albert Flemming, in Langdale, a town in England. Studying the art himself, by finding an old woman who had spun from her youth. Mr. Flemming became most proficient, and so much interested that he established an industry in the region, loaning wheels and giving flax to all who desired. It has proved a great success, so much so, that at the yearly gathering, or social tea, of the members, when they are asked if they wish to give up their wheels, the answer is most emphatically, no. The replies even show an eagerness to add more opportunities to others in the neighborhood.

For the women, it proves a source for extra pennies, which add to their household comforts,

and spending industriously many long winter evenings, perhaps otherwise given solely to gossip.

The invention of the spinning wheel has been given by tradition to an inhabitant of Nodville, and the following tale has been taken from the account of one Sir Henry Hunlock.

FAIRY TALE

There was once an old woman and her daughter, who lived at the side of a hill, in the midst of a forest, near Nodville. They were poor and their only support was obtained from selling the thread which the daughter spun with her spindle and distaff. During the long winter when the roads were so bad that merchants of the surrounding country could not come to purchase the thread, the daughter, one of the most beautiful of creatures, worked without ceasing to spin enough thread to enable her to purchase a cloak for her mother, and a scarlet shawl for herself.

It happened that the King's son of that country, who was an only son, while out one day deer hunting, lost his way in the forest, and called at the widow's cottage to inquire the way. He was pleased with the girl's beauty, and not less with the numerous skeins of yarn which lay upon the cottage floor, showing her skill and industry.

He inquired how it happened that she had collected so much, and the old woman replied that she had spun it all in a week. "In a week!" exclaimed the astonished Prince. "If this be true, I have found a 'gal' more worthy of attachment than any other in the whole country." I will send you a load of flax and if she has

it spun at the end of a week I will make her my bride, but if not, I will have you both killed for deceiving the son of your sovereign."

A long train of camels on the next day laden with flax, stood before the door of the cottage. The driver unloaded them, and told the girl she must spin this all in a week or prepare for death.

After they had departed, she was crushed with despair, she went into the forest and sitting down under a tree, wept bitterly. While she was weeping a decrepit old man came up to her and inquired the cause of her tears. She told him the whole story. "Do not weep, daughter," he said, "I will execute every one of the tasks imposed upon you by the Prince, provided you will either give me your oldest son when he is twelve months and one day old, or that you shall in the intervening time find out my name." She agreed to the terms at once, and in some mysterious way the old man conveyed the flax away, and an hour before the Prince arrived, returned the finest and best twisted thread ever seen in Nodville. The Prince made the girl his bride, and conveyed her and her mother to the beautiful palace which stood on a very high hill and cost a great deal of money.

Every Monday before sunrise the Prince gave his wife a quantity of flax which he expected to be spun through the week, and every Saturday night the yarn was made ready by the mysterious old man. At length the Princess became the mother of a beautiful boy, and the thoughts of the bargain she had made drove her distracted. Every effort she made she could not find out the name of the wonderful spinner, and every time he came he reminded her of her promise, and that the time was near when he had a right to claim her child.

One evening as she sat oppressed, her husband inquired the reason of her sadness, but she was unable to answer him a word. "Come, my love," said he, "do not be

cast down and I will tell you an interesting story: While out hunting to-day I lost my way in the forest — I thought I heard a human voice, and following in the direction of the sound, I came to a cave where I saw an old man, who did not notice me, so deeply was he engaged in his work, a strange sort of labor. He was spinning, not as you do with the distaff, but with a wheel, which flew round as rapidly as lightning — and gave out a sound like water falling from a mountain torrent — all the while he never ceased singing:

My mistress, little she knows my name,
Which shan't be forgot, which shan't be forgot,
When a Prince is heir to the fortune I claim,
Of Walloty Trot, Walloty Trot.
I come at the end of a year and a day,
And take the young Prince, my heir away.
With my whack! she goes!
While nobody knows
My trusty machine
In this cave unseen
Here in this spot
For Walloty Trot.

The Princess made her husband repeat the rhyme several times, until she was sure that she could remember it perfectly. When the old man came to claim her child, "Stop neighbor," said she, "there goes another word to that bargain, I have found out your name. It is Walloty Trot." "You have indeed found out my name," said he, my business on earth is well-nigh finished, but before I depart I am bound to tell you the secret of my art." He went into the forest and returned with his wheels. He then taught the lady their use—showing her that he could spin sixty-six times more with them than she could with the distaff—and then vanished, after which he was never seen again in that part of the world.

The prince and princess taught this new branch of industry to their subjects — which so enriched them that all the surrounding nations regarded them with admiration.

— *Sir Henry Hunlock, 1812. British Folk Lore*

WEAVING

The art of weaving, though very ancient, has been considered the distinctive feature between the savage and civilized tribes.

Weaving is the art of interlacing threads, that is, alternating one series over and under another to form a texture.

The Egyptians have been credited with the invention of weaving, and on the tomb walls of Beni-Hassan, there are two kinds of looms depicted, one horizontal, the other vertical. (Wilkinson, Chapter IX., Plates 386, 387.) Herodotus describing the methods of weaving used by the Egyptians says that "Other nations made cloth by pushing the woof upwards, the Egyptians on the contrary press it down." In a document, written by Pope Alexander VI., the antiquity of weaving is credited to the invention of one man, while other authorities claim the knowledge originally came through some supernatural agency.

“It appears,” says his Holiness, Pope Alexander VI., “that the world was first indebted to one Arkite Chiden Ghelen, an extremely ingenious artisan of Nodville, for the first regularly manufactured piece of cloth ever produced on the surface of this terrestrial globe; and although it was akin to what we at this time and generation call matting, and produced by twisting and interlacing leaf, stems, and fibres together, yet the workmanship cannot be surpassed by the manufacturers of Bolton cloths of the present day.” From this it would appear that his Holiness had a sample of the cloth actually in his possession. Perhaps sewing the fig leaves, as mentioned in the Book of Genesis, has reference to this same process—an obvious improvement of the garment of leaves, which was suggested by twisting the peel of rushes into fine strings, by which means superior textures were produced; but this improvement was not adopted generally, in the part of the country of which I speak, till after the death of Methuselah.” “It did not escape the notice of the mat weavers, that their work was more flexible and agreeable to the wearer (particularly for under-garments), by the use of a finer fibre, and accordingly we find that numerous trials were actually made with the

fibres of various kinds of plants, such as those of hemp and flax species."

As referred to in the historical notes, weaving was mentioned frequently in the Bible, and in the classic literature of the Greeks. Virgil, who was a realist in his portrayal of nature and man's share of labor, gives a vivid scene of the art of weaving, when he describes a contest between Minerva and Arachne. In the *Metamorphoses* of Ovid, the art of making linen cloth was attributed to both contestants. It was for merit of the invention that the challenge was supposed to have been made — Arachne, proud of her ingenuity in the art, presents the challenge.

Both take their stations and the piece prepare,
And order every slender thread with care,
The web enwraps the beam, the reed divides,
While through the intervening space the shuttle glides
Which their swift hands receive, then poised with lead
The swinging weight strikes close the inserted thread,
Each girds her flowing garments round her waist,
And plies her feet with dexterous haste."

Minerva is enraged that she should find a rival, and be outdone by Arachne; in her rage she strikes Arachne with her shuttle, and wounds her pride, which causes Arachne to hang herself. Minerva, regretting her deed and touched

with compassion, transforms Arachne into a spider, in this way perpetrating her art until this day.

(See Ovid, *Metamorphoses*, Book VI., Fable 1.)



THE RUSSIAN LOOM

LOOMS

The first looms were probably stretched upon the ground. Then vertical looms were made—the threads were wound on a pole which rested upon two upright posts, and the threads were attached to a pole on the ground. The weaver carried the thread of the woof to and

fro with his fingers, over and under the warp threads. A reed was then used to press the thread down and make the texture firm. The first kind of instrument employed to carry the thread was like a knitting needle, having a hook in one end, which held the end of the thread. A shepherd's crook originated from this design.

The principles of all early looms are the same. The one most familiar, similar to the Russian loom in the illustration, has four upright posts (in this frame the two forward ones have been cut off); these are held together by cross-beams. At the front is a beam upon which the material is wound as it is woven, while at the back a beam holds the wound warp — this is raised and lowered according to the amount of yarn upon it. The lay is suspended not far from the front — it is used to press the threads of the woof together.

Behind the lay are the heddles, hung from pulleys, which connect with the treadles under the frame work, and are raised and lowered at will. The heddles are composed of loops in the centre of each piece of twine; there are as many heddles as there are threads in the warp, which are passed through the loops. For plain weaving two heddles are sufficient, and

these are threaded alternately, so that half of the threads are raised at once, through which the shuttle can be passed; then the other heddle is raised, and the shuttle passing back completes the web, by passing through the other half of the threads of the warp. The lay is then swung against the weft and presses it into place.

This simply constructed loom has received many improvements — automatic devices applied to almost every part, until at first sight, the great power-looms of the modern factory seem to be machines with complicated principles, but they are all built on the fundamental principles of the earliest weaver.

When patterns of varied colors were desired, or even plain patterns on plain goods were desired, the arrangement of the heddles was more complicated and there was often a great number of them. In the weaving of many patterns, the assistance of a boy was required. He was called a draw-boy, and had a seat above the frame, where he could raise and lower the heddles at a signal from the weaver. This primitive method has been made an automatic one and patented in the well-known Jacquard Loom, described in a later chapter.

THE WEAVER

The weaver sat by his burden
Waiting the work to begin,
Dreamily throwing the shuttle
Backward and forward between;
Questioning much of the pattern,
Watching for it to be seen.

The shuttle was filled with colors,
Of every shade and glow,
Thoughtless, he scattered the radiance
Falling above and below.
The pulse of the loom was beating
Solemnly to and fro.

The throb of the loom grew stronger,
The shuttle flew faster between;
One thread seemed a line of shadow,
Another a ray serene,
But the solemn loom wove together,
Equally, shade and sheen.

III

PROCESSES OF MANUFACTURE

It is impossible to state briefly the gradual development of machine processes, which led to the establishment of factories for the production of linen fabrics to supply the demand of modern social life. The factory, that is the manufacturing plant, so-called, which includes the uses of all kinds of machines run by power, for the preparation of the fibre, spinning and weaving of material desired, is a product of the last century.

Colleges or factories of the olden times consisted merely of groups of workmen that either spun the thread, or wove the cloth; each series of processes determined a completed task.

To-day the textile is all manufactured within the same plant. Although the industries of this country are fully developed and our resources of production are very large, yet to study the best manufactures of the finest linen fabrics, it is necessary to visit the factories of the "Old World." There are many reasons

for this, the principal one being the large interests in this country in cotton industry to the exclusion of flax; secondly, the great value of the product of flax seed and its products; thirdly, the lack of skilled labor in this country for the growing and handling of large quantities of flax. The three reasons explain the importation to the United States of flax yarns, used in the product of linen cloths; while the importations of the fibre are used principally for thread, twines, and rope manufacture, also for the cheaper grades of linen. Our finest linens come consequently from Ireland, Germany, France, and other European countries.

For half a century, Belfast has been one of the leading centres of the linen trade, and through the interests of the Royal Flax Society of Ireland, which received at one time the recognition of Queen Victoria as well as contributions from the English government, the Belfast mills have greatly increased the number of spindles and send to all the leading markets of the world their fine linens.

Through the courtesy of the representative of the York Street Flax Spinning Company, of Belfast, Ireland, the illustrations here used have been obtained, and the different processes made clear.

THE FACTORY

The processes of the manufacture of flax vary with the quality of the flax, and is also dependent upon the purpose for which it is to be used. To determine the specific use and purpose to which each kind of flax fibre is best



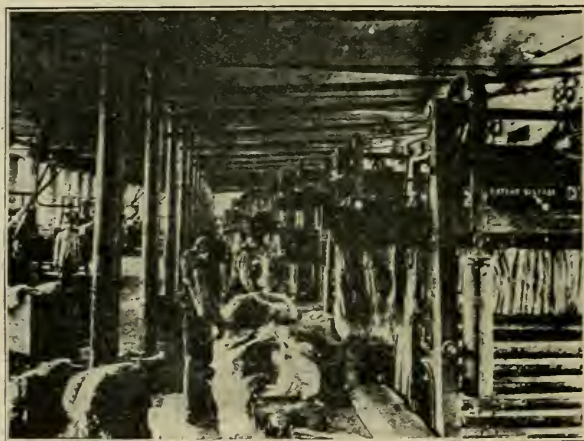
ROUGHING THE FLAX

adapted requires a long, practical experience, and is of value to every manufacture.

In giving the following mill system, therefore, only the processes in general use can be discussed, as often modifications are made or processes are repeated to obtain textile of a special quality.

The commercial flax from the storehouse

supply, first passes to the "roughing" department of the mill, where the bundles are opened and divided into handfuls of a certain size. They are then "squared" by being drawn through a coarse comb or hand hackle, where the loose ends and straggling bits of fibre are combed out, the pieces left in the hackle are

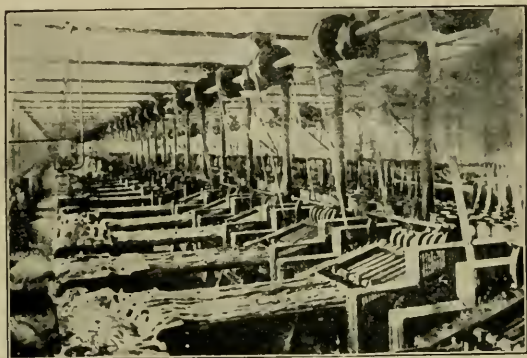


MACHINE HACKLING

removed by hand and placed evenly with the bunch. This operation is renewed several times, until the lumps, knots, and coarse tow have been removed, the bundles opened up and when combed are laid carefully in cross bundles, and sent to the machine hackling room.

"Machine skill and practical experience are

required to hackle the different kinds of flax with the machines best adapted with gradation and number of hackles, and to regulate the speed of sheets and head. Each bundle of flax is fastened on a rod at the top of the machine, moving from one side to the other. Beneath the flax is a revolving roller, made of slats on which are hundreds of fine wire pins; as the



THE SPREAD-BOARDS

wheel revolves, it seems to creep gradually up the strips of flax, combing them, and stripping out the roughened ends and coarse fibres. This machine is known as the "hackle machine." The flax is removed and passed through this machine several times if the fibre is desired of extreme fineness.

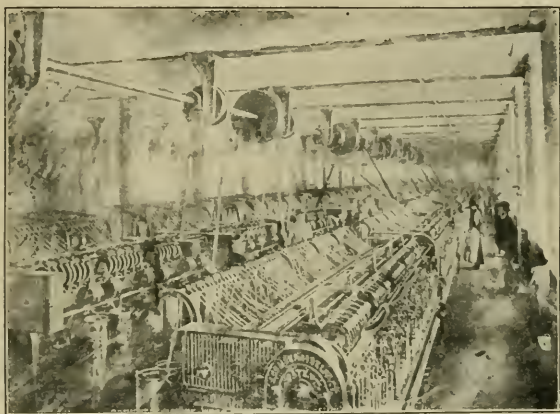
The term "preparing" is given to the three

different processes which follow the hackling. The system begins with the "spreader," or the machine sometimes named the first drawing. The bundles of hackled flax are placed on the boards of the spreader, and fed to the machine, which draws them in over between fluted rollers, and traverses a series of hackles; the fibre is then caught by a pair of drawing rollers, and becomes a ribbon-like form called a sliver. The machine has drawn out the fibres and laid them parallel; as the sliver comes from the machine it falls into a high tin can. Each spread table usually contains six-line spreaders. This drawing process is repeated over and over again by placing several slivers together, forming and equalizing a smoother and more perfect sliver.

The next machine, called the "roving frame," is one of the most complicated. It consists of twisting the fibre into a rove or loose thread. This is accomplished by the addition of a bobbin and flyer to the drawing rollers. "The bobbin is made to revolve with such speed as to wind up the rove as fast as it is yielded by the last pair of rollers, and the flyer with so much additional speed as to give the sliver the desired twist while moving between the roller and bobbin." If the sliver was not twisted it

would not hold together to pass through the spinning frame. These machines are fed from the cans which hold the sliver from the drawing frames, and for the first time the fibre is wound on bobbins. 14863

The waste material that results from the drawing and roving machines is called tow, and is used for manufacture of cheap materials.



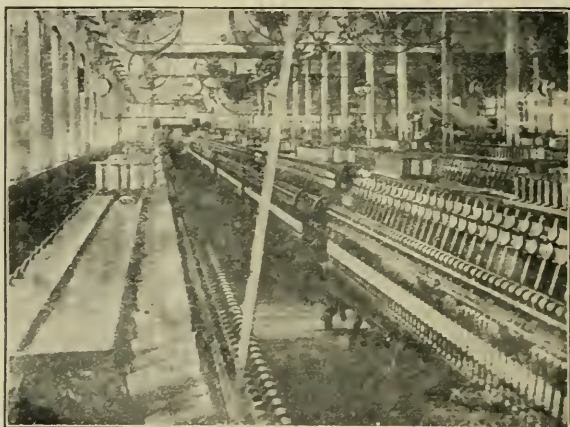
DRAWING AND ROVING

It is prepared on carding machines, similar to those used for short staple fibres like cotton.

Machinery was first applied to spinning without the aid of water, but it was found that the heat and water softened the "greasy principle which binds the cells together," and allows the thread to be drawn and attenuated to a

greater degree, as well as making them finer and smoother.

In the dry spinning frame the bobbins of flax are arranged in rows in an inclined plane on the top of the machine. The rove passes through a first guide, then is caught by nipping rollers, thence through drawing rollers, to the

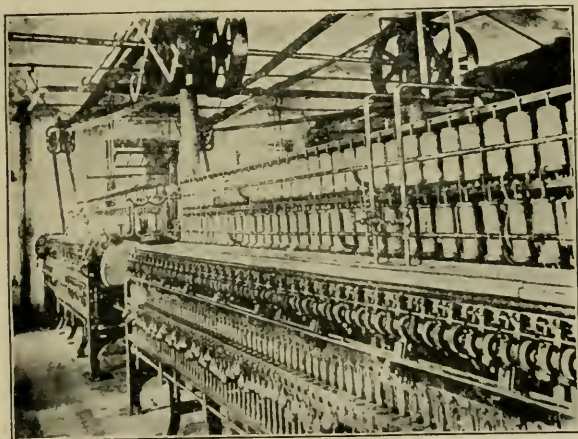


SPINNING

flyer which gives the required twist, and finally to the bobbin. The machine for wet-spinning is similar, although the bobbins are placed in a perpendicular position above the frame, and the rove passes through a trough of water before entering between the rollers.

Napoleon wishing to strike a blow against

the British manufactures of cotton, offered a reward of one million francs to an inventor of the best machine for wet or dry spinning of flax. Phillipe de Girard, hoping to avail himself of the reward, patented machines, but receiving no recognition from the French government, accepted an invitation from Austria to establish mills there, and for a time was successful.



DOUBLING

England, however, stimulated by her success in cotton manufactures, aroused interest in the spinning of flax, and in 1787 two men of Darlington perfected patents that completed the system of mill spinning and firmly established the production of linens.

The process that follows the spinning of the fibre consists in the doubling and trebling it, until of required quality and strength. It is then reeled from the bobbins into hanks. There is a law in England that requires that the standard measure of a hank of flax yarn shall be three hundred yards, called a "cut" or "lea." Each



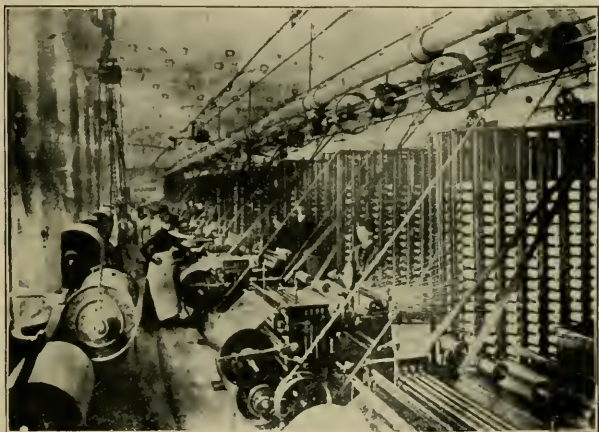
BUNDLING

thread in the hank is two and one-half yards long. One hundred and twenty threads form a lea. Thus when the term "50 lea" is used, it means that there are "50 leas" of three hundred yards each, in a pound.

The original stick of flax laid on the feeding rollers, doubled, drawn and extended in the

spinning frame, produces from one yard of hackled line, about 9,400 miles of yarn.

The hanks of yarn are carefully examined to discover imperfections in bad piecings, or the formation of double threads, lumps, or swells; they are also carefully counted, then tied into bundles. The skeins of yarn are

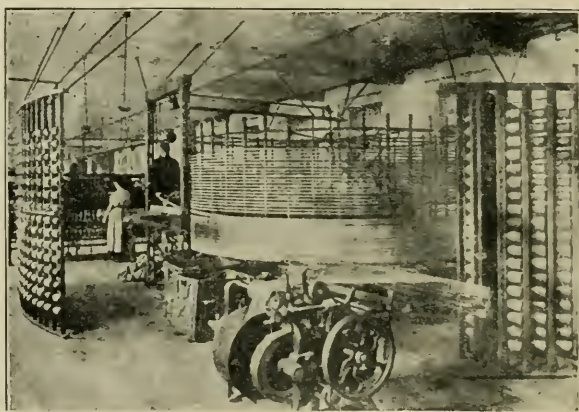


MACHINE WARPING

stretched across pegs, which hold five or six hanks; they are tied together in bundles weighing about forty pounds, termed a "press bundle." The yarn is then ready for the market and is conveniently handled for commercial purposes. If the yarn is to be used in the factory for weaving or finished

thread, it is wound again on large wooden spindles.

These spindles or spools are ready, either to be wound on bobbins for the weft of the material, or for the warp. The latter threads are wound on a warping beam from an upright frame, which holds as many spools as there

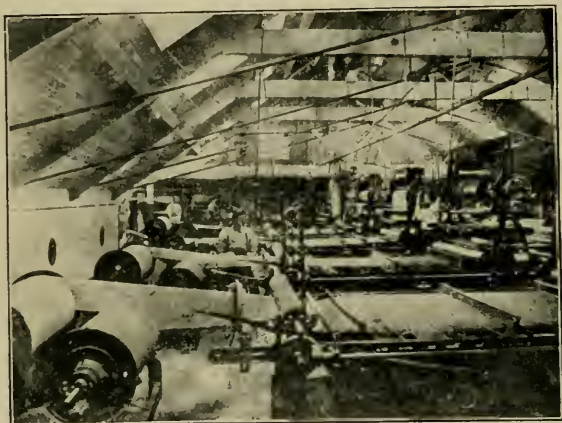


HAND LOOM WARPING

are threads in the given width of the material to be woven — this is called “warping.” The warp is frequently dressed before being woven. This is done by passing the threads through a preparation of sizing, then over heated rollers, in order that the threads may be perfectly dry before being wound on the beam. Another treatment sometimes given is to pass the threads

over a cylinder of flour paste, and in a trough of paste, which is equalized by a series of brushes in the machine, and dried on steam heated cylinders. This preparation is to facilitate the machine process of weaving.

The next process takes one to the room containing the vast number of power looms, one

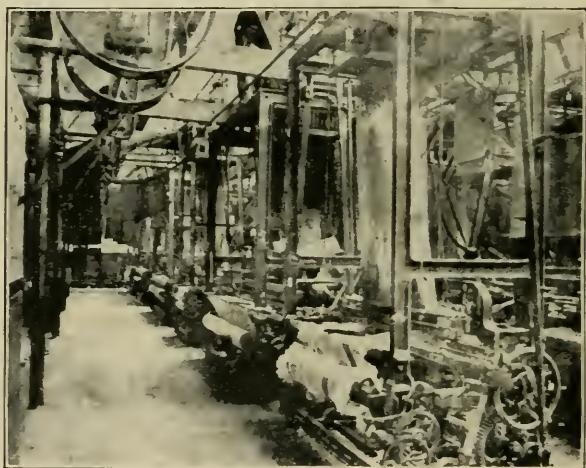


DRESSING OR SIZING THE WARP

of the seemingly noisiest places in the factory. It might be conceded to be also the busiest place, for the shuttles in the great machines fly back and forth with such rapidity that their actual flight can hardly be discerned. One notices the rising and falling of the machine lay as it presses the woof into place. This machine

impresses one as the culmination of all inventions. Especially is this true of the great Jacquard loom. No matter how intricate the pattern, or varied the colors, this wonderful machine accomplishes the work with a precision that is certainly a perfected art.

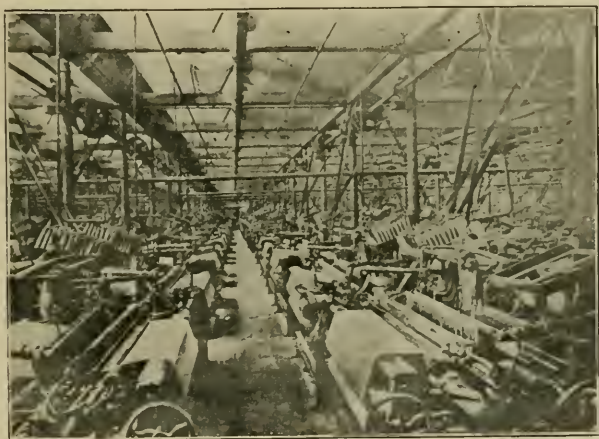
The same principle is applied in the power



JACQUARD LOOM WEAVING

loom that was explained in the primitive loom of the Russian peasant. The many devices and automatic appliances, that at first glance seem to complicate the ordinary power loom, are useful merely in facilitating the quantity of material woven, and the texture desired.

The woven material is placed next into a machine, where it undergoes a process termed "beetling." The material wound on a roller is placed in the machine, and as it is re-rolled on another cylinder, a series of arm-like pieces fall with force on every part of the cloth, pounding and beating out all of the uneven places in the goods.



POWER LOOM WEAVING

If the market calls for an unbleached material it passes on to the "finishing machine," where the gloss and finish are given it by heavy rollers. But if on the contrary the material desired is to be a glistening white, pure in color, it then follows a process of bleaching.

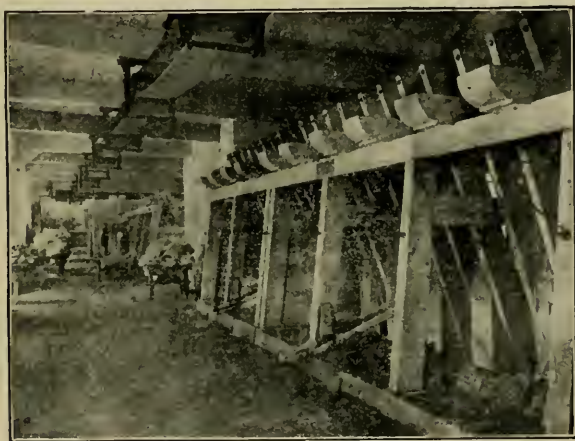
This varies in every manufacturing establishment, according to color required. It is placed generally first in vats containing chemical solutions best adapted for the material.

BLEACHING

The art of bleaching has been known from earliest ages. The different methods and substances used varied with each country. Pliny writes that the Gauls and Britons both understood a process which he describes: "They made a bleaching soap of the fat of animals and the ashes of certain vegetables." He claims this method was invented by the Gauls. The people of Holland in early times produced an excellent cloth, by a treatment of buttermilk and lye, followed by washing in black soap and being spread on the grass for two or three weeks. The French used a similar bleaching process. Some celebrated chemists in the last half of the nineteenth century, experimented with chemicals for bleaching, and applied chlorine in the whitening processes. Since then some improvements have been introduced, and bleaching has become an important branch of the linen manufacture.

The linen, after remaining in the bleach vats for a certain length of time, is removed and loaded on carts to be carried to the bleach fields. Grassy meadows are arranged on purpose for the process, called "bleach greens."

There are many bleach fields in the country near the factories, established and supported by a Board of Trustees, with special rules and



THE WASH MILLS

regulations. These fields vary in size from seven to twelve acres. In some instances, and some factories, the bleaching is all done with the chemicals. While the cloth is out on the grass it has to have special attention, frequently being dampened and turned.

Upon the return of the linen from the bleach-fields, it is placed on the scrub-boards, where it is washed and cleaned of all particles of dust and dirt. Then a process of blueing follows, and drying by passing the material over a series of heated cylinders. The mangling machines, into which the linen next passes, are built with



CARTING LINEN TO THE BLEACH FIELDS

heavy rollers — they iron and press the linen, giving to it the finish and lustre that is its chief characteristic.

Machines for measuring, folding, and finishing follow: and operations of labeling the goods and packing are given careful attention to prepare them for the market.

The products of manufacture of the mills have been developed within a century of time, but their quality has not excelled, even with all the modern devices, the textures of the ancient looms.

A machine made article loses the marks of the hand craft, while the home-spun is given



THE BLEACH FIELD

a charm of texture that is individual with the weaver. The same distinction that is found between the hand-carved panel and that made by machine.

Modern life and its demands, with the value of time ever present, could not be amply supplied with sufficient materials if the spinning

wheel and the loom was exchanged for the great organizations of machine processes and labor.

But notwithstanding this, the value of the fine hand linens is greater than that of the machine-made to-day, and a piece of linen, even of the immediate past generation, is treasured with pride for the skill displayed, and as a monument of a household industry.

IV

FLAX CULTURE AND LINEN MANUFACTURE IN THE UNITED STATES

“In colonial times efforts were made to promote the growth of flax, and to introduce the spinning and weaving of the fibre. It was the policy of the mother country to suppress manufactures in the colonies, but the production of linen goods was a domestic industry which England could not and did not try to prevent. The cultivation of flax was undertaken on a small scale, and the spinning-wheel and the hand-loom were the only available machinery for working it into cloth. It is probable that there was in America scarcely any manufacture of linen for sale — that which was made was a home product intended solely for consumption in the families of the weavers.”

Dr. Horace Bushnell writing of these times in 1851 says: “If our sons and daughters should assemble, a hundred years hence, they will scarcely be able to imagine the Arcadian picture now so fresh in the memory of many of us,

though to the younger part already matters of hearsay more than of personal knowledge. The spinning-wheels of wool and flax that used to buzz so familiarly in the childish ears of some of us, will be heard no more, in fact save in the halls of the antiquarian societies, where the delicate daughters will be asking what these strange machines are and how they were made to go? The huge hewn-timber looms that used to occupy a room by themselves in the farmhouse, will be gone, cut up for fire-wood, and their heavy thwack, beating up the woof, will be heard no more by the passerby. The long strips of linen bleaching on the grass and tended by a sturdy maiden sprinkling them each hour from her water can, under a broiling sun, thus to prepare the Sunday linen for her brother's and her own outfit, will have disappeared, save as they return to fill a picture in some novel or ballad of the old time."

Edward Stanwood in the Census Report for 1902 adds to these colonial pictures — "that it is extremely probable that the desire of the American people to introduce manufactures, thus supplementing their political with industrial and commercial independence, would have led them to engage largely in the production of linen fabrics had not the invention of the

cotton-gin, by Eli Whitney (patented in 1793), placed in their hands a cheaper fibre than flax, more tractable, requiring less preparation, more easily spun and woven, superior for many purposes and decidedly inferior for very few."

The domestic production gradually died out, and the Congressional Commission report in 1864 states that, "It is well known that the only mill of this class in our country fully equipped for spinning and weaving fine, long line yarns (located at Fall River, Mass.) was after a great outlay of capital and immense exertions to operate at a profit, converted into a cotton mill at a heavy loss, in consequence of an insufficient home supply (of raw material), the mill being precluded from using foreign stock by a practically interdictive duty."

To a certain extent, this condition has been improved, but the fibre still grown in this country is not adaptable for fine linen yarns or fabrics. It has been proved that the finest flax can be grown in this country, but it requires skilled workers. Should the spinners of the United States establish local industries of scutching mills in localities where the farmers could find a ready market for the straw that produces standard fibre, machines would soon be available for handling large crops and our country

could easily outstrip the supply of foreign markets.*

Flax is cultivated for the fibre on a commercial scale only in the eastern part of Michigan, in the vicinity of Salem, Oregon, and near Northfield, Minnesota. Most of the flax used in the manufacture of linen goods is imported from European markets or from Canada. The cheaper grades of flax fibre are used for carpet yarns, for shoe thread, toweling, cordage, twine, jute burlaps, and baggings. In many of these productions, hemp and jute are combined with flax. There are one hundred and forty-one factories in the United States for this kind of manufacture; they employ about twenty thousand men, which seems a small number in comparison to three hundred thousand employed by the cotton manufacturers. The principal factories are located in Massachusetts, New York, Pennsylvania, Connecticut, New Jersey, Rhode Island, and Wisconsin.

There are fifteen establishments for the manufacture of pure linen goods, with a capital of about six and one-quarter million dollars (1905).

United States statistics of imports from the Census of 1902† are as follows:

* See United States Report, No. 27 — C. R. Dodge.

† In 1902 the Department of Agriculture made its first official report.

Flax hackled, known as "dressed line"	1,481	tons.
Flax not hackled or dressed	5,096.83	"
Flax, tow	1,888.06	"
Flax, yarns	1,088,938.00	lbs.
Twines, threads, or cords composed of flax, hemp, or ramie, of which these substances, or either of them, is the compound material of chief value, in yarns not finer than 5 lea to 335 lea	491,637.62	"
Total value of manufactured and unmanufactured flax yarns and linen goods imported	\$ 70,476,038.25	

FLAX SEED

From one of the minor industries of the United States in 1810, the cultivation of flax for its chief product, linseed oil, has become one of the largest. Linseed oil is used principally for home consumption, while its one by-product, lin-seed oil cake, is a chief article in the lists of exports.

The crop of flax and the industry of oil-making has been defined as a migratory product, because with the development of the West the interests in the crop have followed the farming interests in new states and territories, designated by the

North-western and South-western districts, the former including the crops from North and South Dakota, Minnesota, Iowa, and Wisconsin; the latter including Kansas, Missouri, Nebraska, Oklahoma, and Indian Territory.

Only two or three pecks of seed are sown to the acre, yielding very coarse straw, but large quantities of seed. There are two varieties of seed — one small-grained, yielding from sixteen to seventeen pounds of oil to the bushel — the other, large-grained seed, which yields from eighteen to twenty pounds to the bushel.

Linseed oil is the chief product of flax. Owing to its drying properties, it is indispensable for paints and varnishes, having no adulterant or substitute except corn oil. Two operations are used in the manufacture of the oil, one termed the "old process," the other the "new"; the former, by hydraulic pressure, the latter, by a naphtha process. In the old process the seed is first crushed between high-speed steel rollers into a fine meal. The meal is then heated in reservoirs either by injecting steam or the use of steam-jacketed heaters.

"The meal is then drawn from the heaters into cake formers, machines which compress it into a shape of just sufficient consistency to allow, by careful handling, of its being folded in a woollen

cloth and placed in the press. Although the press is universally taken as a uniform productive unit, the presses in different mills may really vary in productive capacity according to the number of 'plates' they contain, each plate, located one above the other in the press, simply representing a separate compartment for the reception and compression of the meal that has been put into proper shape by the cake former. These plates may range in number from sixteen to twenty-six to the press, but since the usual and average number is about twenty plates to the press, it is obvious that the common custom of estimating capacity by presses answers all comprehensive purposes. The presses, massive pieces of machinery, are arranged in rows in 'batteries' of either five or six presses each, and a force of three men is required for each battery. Beginning at one end of a battery the separate compartments of the first press are filled with the slightly compressed meal, powerful hydraulic pressure applied at once, and so on with each press of the battery in succession. The operation of emptying and filling each press requires about ten minutes, and hence it is apparent that in a battery of six presses each press is under pressure for an hour, the oil meanwhile flowing from the

presses into tanks. At the expiration of that time the hydraulic pressure is taken off from the press first filled, and now hardened oil cakes removed from between the plates, the press refilled with meal and the other presses emptied and refilled in the same way in succession, and so on indefinitely. The oil is then forced through filter presses for the purpose of removing mucilaginous substances known as 'foots,' after which it is placed upon the market as raw oil; or, after filtration, its drying properties may be increased by boiling and the simultaneous addition of litharge or other dryers, in which case it is known to commerce as boiled oil. Numerous brands of refined oil also result from various processes of refining."

The "new" process is a chemical one, the oil being extracted from the seed by the action of the volatile solvent, naphtha. As in the old process the productive unit is the hydraulic press. In this process the distinctive feature is the percolator, a huge iron tank with a capacity for holding about three thousand bushels of seed. The flax-seed after having been crushed into meal as in the old process, is dumped into the percolators, and flooded with naphtha. The naphtha having an affinity for the oil, extracts

* United States Report Flax-seed Production, 1902.

it from the meal, and after the requisite length of time is drawn off through a valve in the bottom of the percolator, a common product of linseed oil and naphtha. The naphtha is then evaporated and condensed for further use, and there is left the commercial product, linseed oil. The "by-product" is a meal which is dried and deodorized and used as a food for cattle.

The entire crop of flax-seed for the year of 1908 was estimated at 25,805,000 bushels; about fifty per cent of this was grown in South Dakota. The yield of oil from this amount is also estimated at about 67,500,000 gallons, while the product of oil cake is at least one thousand million pounds.

The Great Lakes are the centres of the product, which have Duluth, Superior, and Chicago for their principal markets, largely owing to their water facilities.

The oil cake is the chief product for exportation, but it has a limited demand in the United States. It is considered a valuable food for cattle and is largely consumed in the milk and stock farms of Northern Europe. The principal ports of the export are those of the United Kingdom, Denmark, Belgium, France, and Germany.

Some of the other products manufactured from the oil are linoleum, oil cloth, oil silk, printers' ink, and patent leather.

FLAX .

The flax was in bloom; it had pretty little blue flowers as delicate as the wings of a moth or even more so. The sun shone and the showers nurtured it.

"People say I look exceedingly well," said the flax, "and that I am so fine and long that I shall make a beautiful piece of linen. How fortunate I am! It makes me so happy; it is such a pleasant thing to know that something can be made of me."

One day, some people came who took hold of the flax and pulled it up by the roots; this was painful; then it was placed near the fire, as if it were to be roasted. "We cannot expect to be always happy," said the flax, "for by experiencing evil as well as good, we become wise." It was steeped, roasted, and combed. At last it was put on the spinning wheel. "Whir, whirl," went the wheels, *so* quickly that the flax could not collect its thoughts.

"Well, I have been very happy and must be contented with the past," and contented he remained until he was put on the loom, and became a beautiful piece of linen. "Well, this is quite wonderful, I could not imagine that I should be so favored by fortune — after all I have suffered, I am made something of at last, I am the luckiest person in the world — so strong, so fine, and so white. I have a great deal of attention every morning — the maid turns me over and sprinkles me, and the clergy-

man's wife noticed me, and said I was the best piece of linen in the whole parish. I cannot be happier than I am."

After some time the linen was made into garments. The flax then said, "Now I shall be of some use in the world as everyone ought to be—it is the only way to be happy."

Years passed and at last the linen was so worn it could hardly hold together. At length they fell into tatters and rags, and they were made into pulp and dried, and found themselves beautiful white paper. Well this was a glorious surprise. The paper said, "I am now finer than ever, I shall be written upon, and who can tell what fine things I may have written upon me." The most beautiful stories and poetry were written upon it. People heard the stories and poetry, and it made them better and wiser. "I never imagined anything like this," said the paper, "when I was a little blue flower growing in the fields. I suppose now I shall be started upon travels around the world." But the paper did not go on travels, it was sent to the printer and all the words written upon it were set up in type to make hundreds of books. This was certainly the wisest plan, for if it had gone out into the world, it would have been worn out before it had gone very far. Then the paper was tied with a bundle with other papers and thrown into a tub that stood out of the way. "After work it is well to rest," said the paper. "What will be done with me now—I shall go forward." One day all the paper was taken from the tub and placed on the hearth to be burnt up.

"Ugh!" cried the paper, as it burnt into a bright flame. It was certainly not very pleasant to be burnt up, but the flames mounted into the air, higher and higher than the little flax plant had ever been, and they glistened as the white linen had never glistened.

"Now I am mounting straight up to the sun," said a voice in the flames, and the flames darted up through

the chimney and out at the top, and the little voice said,
"The song is never ended, the most beautiful is to come."

— *Translated from Hans Anderson*

Other Fairy Tales

Flax Leavings.

The Lazy Spinner.

The Spindles, the Needle, the Shuttle.

The Three Spinning Fairies.

(See Grimm's Fairy Tales, translated by Paull and Wheatley).

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